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XVIII.

NOTE ON THE PRESSURE COEFFICIENT OF THE VOLTAIC CELL.

By Carl Barus.

Presented January 14, 1891.

Subjecting cells of Zn/Pt and of Zn/Cu, in dilute sulphuric acid and Daniell's cells, to pressures between 10 and 1800 atmospheres, at temperatures between 15° and 300°, I obtained certain results bearing on polarization, the temperature coefficient, and the pressure coefficient of the galvanic couple. For the purposes of the present note I need only give the pressure coefficient, κ, of the Daniell's cell at 15°, $\kappa = -5/10^6$ (volts per atmosphere), whereas the ordinary temperature coefficient is $-200/10^6$ (volts per degree).

The feature of these results, corroborated by my other data, is obvious: the pressure coefficient (volume contraction) and the temperature coefficient (volume expansion) have the same sign. Hence, quite apart from changes of volume, quite apart from what in a liquid corresponds to the mean free path of the molecules of a gas, the observed change of electromotive force is to be associated with the change of the stability, or the vibration status of the galvanic system as a whole. I infer from this, that the secret of the relation of the Volta contact to the Peltier contact, will probably fall into the possession of him who devises means for carrying a suitable galvanic cell, suitably compressed, through a large range of temperature (I mean fully into red heat). For it is thus possible to discriminate between the metallic contacts and the other contacts, by exposing any one or all of them in the thermal field.

An allied electrical result, indicating a specific effect of temperature even on the metallic molecule, I observed some time ago by compressing mercury and a solution of zinc sulphate. I deducted the isopiestic resistance decrement per unit of volume decrement, from the corresponding isothermal resistance decrement per unit of volume decrement, of the same substance. Thus I found that the purely thermal effect of rise of temperature (i. e. the effect apart from change

of volume) is an *increase* of electrical conductivity both for the metal and for the electrolyte. Conduction in metals and electrolytes thus takes place in ways essentially alike.

The present results lend themselves favorably to certain views on the possibility of an ion theory of magnetism which I have indicated elsewhere (Nature, Vol. XLI. p. 370, 1890); viz. that in a magnet the split up or the transfer of charges is directed along paths of closed helices, each of molecular diameter, consisting of right and left handed screw threads, with their ends joined and their axes in the direction of the lines of magnetic force. An advantage is gained in this way, since a definite relation of the magnetic quality to the molecular structure is implied. It may be stated generally, that in metals a definite degree of molecular break up corresponds to each temperature; and that electrical action (appearing either as static charge, current, or magnetism) is manifest, whenever the break up is suitably directed.